(8 pages)

Reg. No. : .....

Code No. : 7793 **Sub. Code : WPHE 23**

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2024.

Second Semester

Physics — Elective

NON LINEAR DYNAMICS

(For those who joined in July 2023 onwards)

Time : Three hours Maximum : 75 marks

PART A — (15 × 1 = 15 marks)

Answer ALL questions.

Choose the correct answer :

1. If the real parts of both the eigen values are zero then the stability nature of equilibrium point is

(a) stable (b) unstable

(c) neutral (d) none

2. Which one of the following is an example of autonomous system?

(a) Kepler problem

(b) Driven pendulum

(c) Duffing oscillator

(d) Driven linear oscillator

3. Hysteresis is present in

(a) nonlinear system

(b) linear system

(c) discrete dynamical system

(d) both linear and nonlinear system

4. Solitons are

(a) stationary waves

(b) liner dispersive waves

(c) linear non dispersive waves

(d) nonlinear dispersive waves

5. The Kdv equation is

(a) $u_t + 6u^2ux + u_{xxx} = 0$ (b) $u_t + 6uu_x + u_{xxx} = 0$

(c) $u_t + 6uu_x = 0$ (d) $6uu_x + u_{xxx} = 0$

6. Which of the following is related to N-soliton solution of soliton equation?

(a) Perturbation method

(b) Painleve analysis

(c) AKNS method

(d) Hirota's bilinearization method

7. Which one of the following is called exchange of stability bifurcation?

(a) Hopf bifurcation

(b) Saddle-node bifurcation

(c) Pitchfork bifurcation

(d) Transcritical bifurcation

8. In ———— bifurcation as a parameter is varied, the stable equilibrium point generally becomes unstable at a critical value and gives birth to two new stable equilibrium points.

(a) Hopf bifurcation

(b) Saddle-node bifurcation

(c) Pitchfork bifurcation

(d) Transcritical bifurcation

9. Which one is the second step in the quasiperiodic route to chaos?

(a) Chaotic orbit

(b) Stable limit cycle

(c) Quasiperiodic orbit

(d) Stable equilibrium point

10. Fractal has

(a) no dimension

(b) integer dimension

(c) non-integer dimensions

(d) none

11. The basic cantor set is an infinite set of points in the interval

(a) $[-1, +1]$ (b) $[0, 1]$

(c) $[0, \alpha]$ (d) $[-\alpha, +\alpha]$

12. A simple example of natural structure with self-similar property is

(a) Koch curve (b) Cauliflower

(c) Julia set (d) Cantor set

13. In communication using chaos, the system possess

(a) very low sensitivity to Doppler effects

(b) low sensitivity to impulsive interference

(c) tolereant to transmitter and receiver nonlinearities

(d) all the above

14. Light amplification in ———— glass fibers allows intercontinental communication at 10 billion bits per second.

(a) Silica doped (b) Erobium-doped

(c) Germanium doped (d) Zinc doped

15. The phenomenon of enhancement of response of a weakly periodically or nonperiodically driven nonlinear system by noise is called as

(a) superhormonic resonance

(b) strange nonchaotic attractor

(c) subhormonic resonance

(d) stochastic resonance

PART B — (5 × 4 = 20 marks)

Answer ALL questions, choosing either (a) or (b).
Each answer should not exceed 250 words.

16. (a) What are linear oscillator? Explain damped oscillations with phase trajectories of the system.

Or

(b) What is equilibrium point? Discuss any two classification of equilibrium points depending upon the nature of eigen values.

17. (a) What are linear waves? Write any three examples.

Or

(b) Write any four applications of solitons.

18. (a) What is Hopf bifurcation? Explain.

Or

(b) Write a note on logistic map in the discrete dynamical system.

19. (a) Explain the quasiperiodic route to chaos with necessary diagram.

Or

(b) Write a note on fractal dimension.

20. (a) Explain the soliton based computation.

Or

(b) Write a note on chaos based communication.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b)
Each answer should not exceed 600 words.

21. (a) Discuss the damped and driven nonlinear oscillators (i) oscillations and (ii) forced oscillations.

Or

(b) Derive the general criteria for stability in the classification of equilibrium points.

22. (a) Derive the Korteweg-de Vries simple nonlinear dispersive wave equation.

Or

(b) Explain soliton in optical fibres with the neat schematic diagram of fibre optical communication system.

23. (a) Explain the simple bifurcations (i) saddle-node bifurcation (ii) transcritical bifurcation.

Or

(b) What is strange attractor? Explain self similar structure.

24. (a) Discuss the intermittency transition to chaos in the duffling oscillator equation.

Or

(b) Explain the applications of fractals.

25. (a) What is cryptography? Explain the elementary chaotic cryptographic system.

Or

(b) Explain time series analysis. Estimate time-delay and embedding dimension.

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